SPECIATION OF CS-137 AND PU ISOTOPES IN POLESSIE STATE RADIATION-ECOLOGICAL RESERVE SOIL, CHERNOBYL ZONE.

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Even though a huge effort has been expended on determining levels of radioactive contamination following the Chernobyl nuclear power plant accident in 1986, within the Belarusian sector of the Chernobyl exclusion zone, information has been inadequate. Speciation, transfer and fate of numerous radionuclides most notably transuranium radioisotopes within in this region are poorly understood.

After deposition, weathering of radioactive particles and mobilization of associated radionuclides occurs with time. The transfer of mobilized radionuclides within the ecosystem will be delayed and depends on the weathering rate. The weathering rate depends on the initial particle composition, structural changes occurring during the event (e.g., transformation from UO_2 to U_3O_8 and U_2O_5, and transformation processes taking place after deposition depending on soil pH, redox conditions and microbial activities (Salbu, Lind et al. 2004).

The Chernobyl accident resulted in the release and dispersion of about 3 % of the irradiated uranium dioxide fuel in the form of “hot particles” of various sizes and degree of oxidation. The ^{90}Sr, that normally is quite mobile, showed a low migration mobility when it was incorporated into fuel particles. However, as fuel particles dissolve due to weathering, the portion of extractable ^{90}Sr in soils increase, leading to higher soil-to-vegetation transfer coefficients. The released fuel particles can be categorized roughly into “non-oxidized” (from the exposion) and “oxidized” (from the following fire) types. Of the total release from Chernobyl NPP, more than 90 % of the radiologically important radionuclides (90Sr, Pu-isotopes, 241Am) were in the form of small (less than 10 µm diameter) fuel particles. Within the 30-km zone, a major fraction of the deposited radionuclides, including ^{137}Cs, were incorporated within the fuel particle matrix, hence contamination levels of ^{90}Sr and transuranics were relatively high (Kashparov, Oughton et al. 1999). In the case of forest fires, the speciation of the deposited fuel particles can be changed due to oxidizing conditions. This might lead to increase in weathering rates in forest fire areas.

In order to assess the mobility of radionuclides and potential availability of radionuclides in the soil, the association with soil components will also influence their subsequent transfer to compartments in the environment, and thereby their mobility in soils and sediments and availability for biological uptake by vegetation. Therefore, soil from within and outside forest fire areas have been subjected to sequential extractions in order to identify the association of radionuclides with the different soil components. Sequential extraction would show the presence of fuel particles in the soils, due to the leaching of refractory particles with the H_2O_2 fraction, and identify any different in speciation between forest fire affected areas and those areas not affected.

Kashparov, V. A., D. H. Oughton, et al. (1999). "Kinetics of fuel particle weathering and 90 Sr mobility in the Chernobyl 30 km exclusion zone " Health Physics **76**: 251-259.
Salbu, B., O. C. Lind, et al. (2004). "Radionuclide speciation and its relevance in environmental impact assessments." Journal of Environmental Radioactivity **74**(1-3): 233-242.